Space Weather Technical Forecast

Issued on Tuesday, 26 July 2022 at 01:15 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Active electron fluence. Slight Chance of R1/R2 throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low during the last 24 hours, with X-ray activity observed at GOES16 generally in mid-B-class with isolated small C-class flares. The largest flare of the past 24 hours was a C1.4 at 25/0833UTC that emanated from a newly-arrived region on the northeastern limb. This was one of up to eight sunspot regions on the visible disc, with most comprising small bipolar regions.

The most significant spot development in the period came from AR3065 and AR3066, which both showed areal growth, spreading and some proliferation of spots, but this was not capped by significant flare activity, and the growth stalled in both later in the 24 hours. The most active group of the period currently appears as an Hrx but is likely to be concealing detail given the narrow viewing angle at present.

Coronagraph imagery for the period showed a marked downturn in Coronal Mass Ejection (CME) activity in the period relative to the UTC weekend, with all observed events being limbward to no anticipated effect at Earth. No Earth-directed CMEs feature in the forecast.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was characteristic of the tail end of a coronal hole high speed stream, probably that from one of a pair of negative polarity coronal holes (CH01/02). The phi angle was accordingly negative (towards the Sun) throughout.

The solar wind speed mainly fell during the UTC day of Monday 25 July from near 500km/s to near 400, before a late resurgence took the speed back nearer 450. The solar wind density was in single figures ppcc throughout, while the IMF was level at or below 6nT, with a north-south range of +/-5nT.

Observed geomagnetic activity generally fell with time, peaking at two provisional intervals of 3- during the UTC early hours, but otherwise being Quiet for the remainder of the day.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16 was at Background levels.

High energy electron flux (greater than 2MeV) varied between Normal Background and High levels, with a peak of 1250pfu observed at 25/1605UTC. Electron fluence displayed a steady increasing trend but remained well below the Active threshold. An observed fluence of 5.07e7 integrated pfu was recorded at 26/0001UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

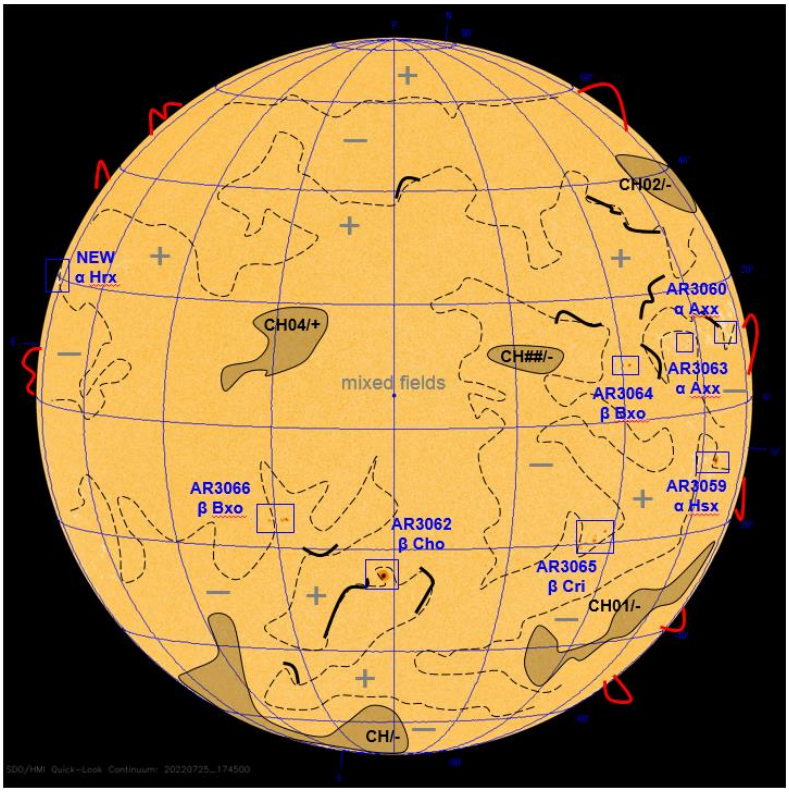
Solar Activity: Activity is likely to remain Low with only a Slight Chance of M-class flares. Barring development, three further regions should leave the Earth-facing side of the Sun in the period, however the eastern solar hemisphere's far side is congested with expected returning sunspot locations, such that activity ought to at least be maintained, pending proper analysis of any arrivals.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast. Solar winds are expected to return to Background levels soon after the start of this four-day period. While there is a small unnumbered coronal hole mid-disc at present, any increase in activity is expected to be very minor and is at least two days away given STEREO A measurements. Geomagnetic activity is therefore expected to remain predominantly Quiet with isolated Unsettled intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to remain at Background levels.

The high energy electron flux (greater than 2 MeV) is expected to display an increasing risk of more protracted High flux (1e3 pfu) on Tuesday 26 July, although should this not prove capable of generating Active 24-hour fluence, then it is unlikely to do so later in the week for the lack of a suitable mechanism (i.e. no significant fast winds). There is a Chance of exceeding the Active (1e8 integrated pfu) level from Tuesday, waning with time in the ensuing slow wind.

Figure 1. Solar Analysis Valid 25/1745UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the forecast.

Earth is currently departing the influence of one of a pair of negative polarity high speed streams - that from CH01 or CH02. These may well be the only fast wind features in the forecast, however there is some suggestion of a tenuous small coronal hole that may feature on or after day three, Thursday 28 July, as this is not a recurrent feature and has yet to manifest at STEREO A, with a two day lead-time to appearing at Earth.

The more definite presence of coronal hole 04 may also fall outside the four-day forecast for being too far east to feature, although this is something of an unknown quantity for changes in geometry since last rotation.

All considered, any coronal hole influence in the period ought to be minor, and mainly Quiet geomagnetic conditions are therefore expected throughout, perhaps most reliably so before midweek given the assurances offered by the quiet trace at STEREO A.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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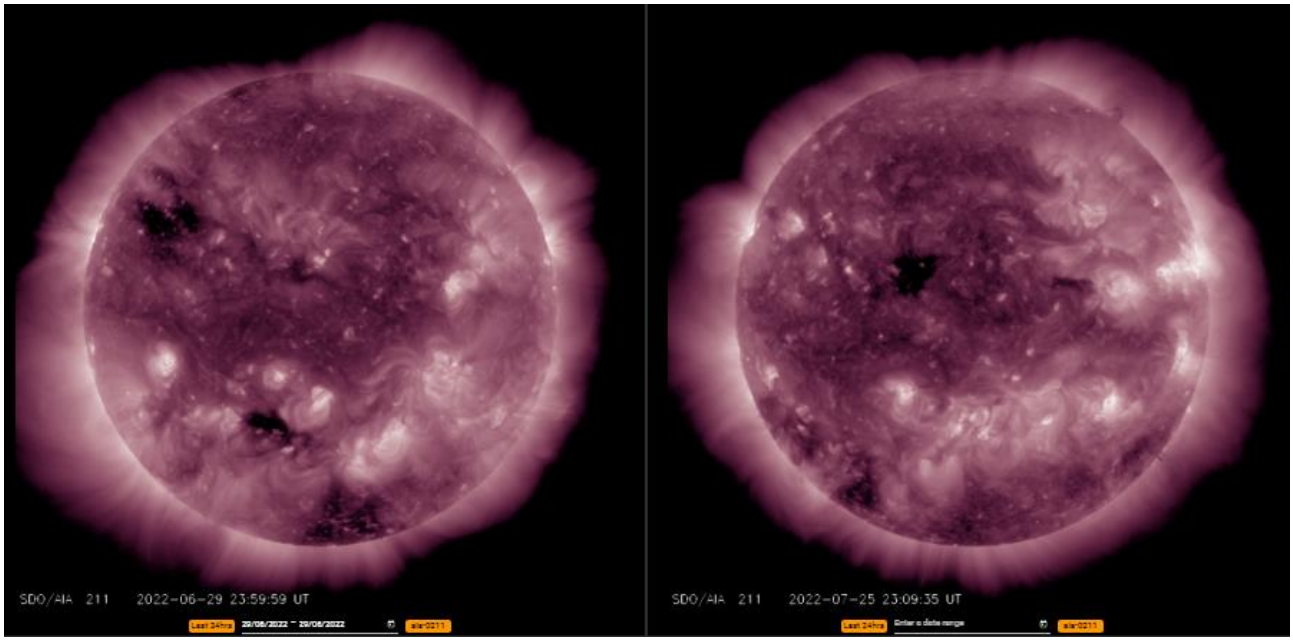
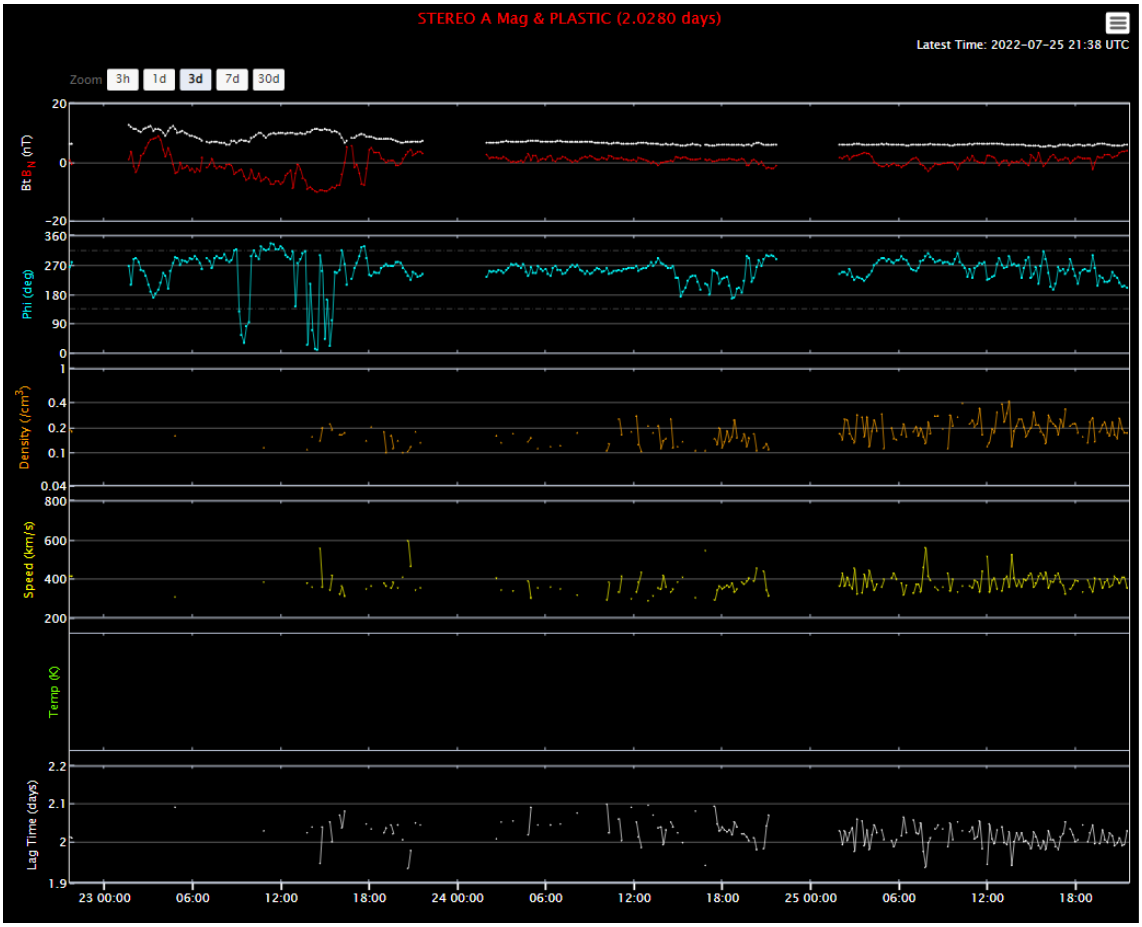
Figure 2: AIA 211 imagery from the previous and current rotations, showing changes in upcoming coronal hole geometry. Also shown is the past three days in STEREO A MAG and PLASTIC measurements, which implies that no enhancements are expected at Earth in the period (barring development or CME influence).




STEREO A Mag & PLASTIC (2.0280 days)
Latest Time: 2022-07-25 21:38 UTC
Zoom 3h 1d 3d 7d 30d
Bt Bn (nT)
Phi (deg)
Density (/cm3)
Speed (km/s)
Temp (K)
Lag Time (days)
23 00:00 06:00 12:00 18:00 24 00:00 06:00 12:00 18:00 25 00:00 06:00 12:00 18:00

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Radio Blackouts - X-Ray Flares:

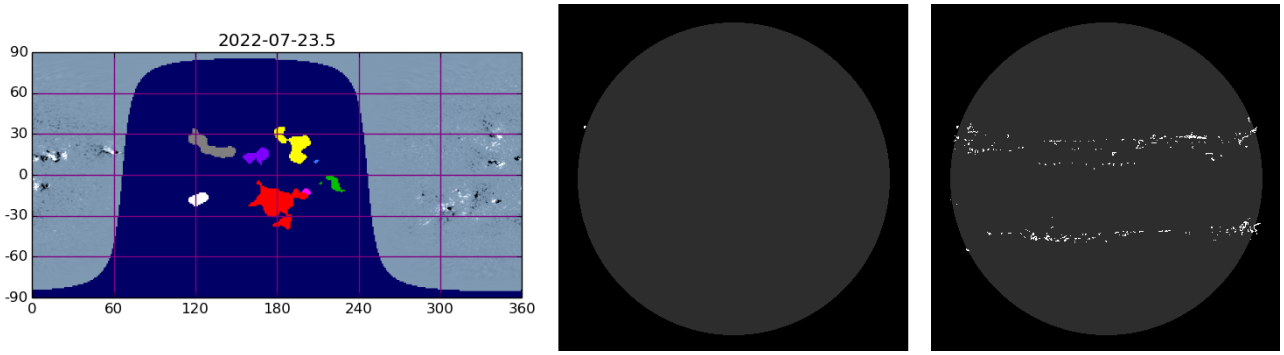
Solar activity has been Low during the last 24 hours, as despite a large cohort of sunspots on the Earth-facing side of the disc, the vast majority are simple, in decay or both, leading to minimal X-ray activity.

The prospects for later in the week are generally for an increase in activity given the returning Carrington locations of several far-side groups, however the degree to which this occurs remains to be seen. Certainly, the number of CMEs observed leaving the far side of the disc to end the past working week and over the UTC weekend implies that at least some of these active regions survive as potent entities.

This means that the chances of significant flares are at least maintained throughout, despite the departure of many of the current front sided groups as the balance of probabilities dictates that at least some of the expected arrivals will show later this week.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GONG Far side sounding from 23 July, showing numerous large potential active regions on the Sun's far side. Also shown are X-ray flares of C-class and above for the past 24 hours (centre) and past fortnight (right), showing the relative lull at present. Centre and right images courtesy of SIDC ROB.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels. Barring significant arrivals or development, and despite the number of active regions in the western solar hemisphere, their apparent inactivity and simplicity make for a low risk of proton enhancement in the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) should soon reach an equilibrium in a new higher diurnal oscillation - a response to the now decaying recent fast wind from coronal hole(s) CH01 and/or CH02. This is likely to bring a more lasting period of High flux from day one, Tuesday 26 July, although the influence of the 21 July CME over the past weekend has clearly dampened the prospects of Active fluence occurring, with electron levels in the Van Allen belt sampled by GOES16 clearly down on those of last rotation.

There is a Chance of Active 24-hour fluence being realised from day one, Tuesday 26 July, but this should be the peak for the four-day period as a whole, and should this level not be reached, it is unlikely to for the remainder of the forecast. A gradual ebbing away of electron counts is otherwise expected in the slow regime that should characterise the working week.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	25	25	20	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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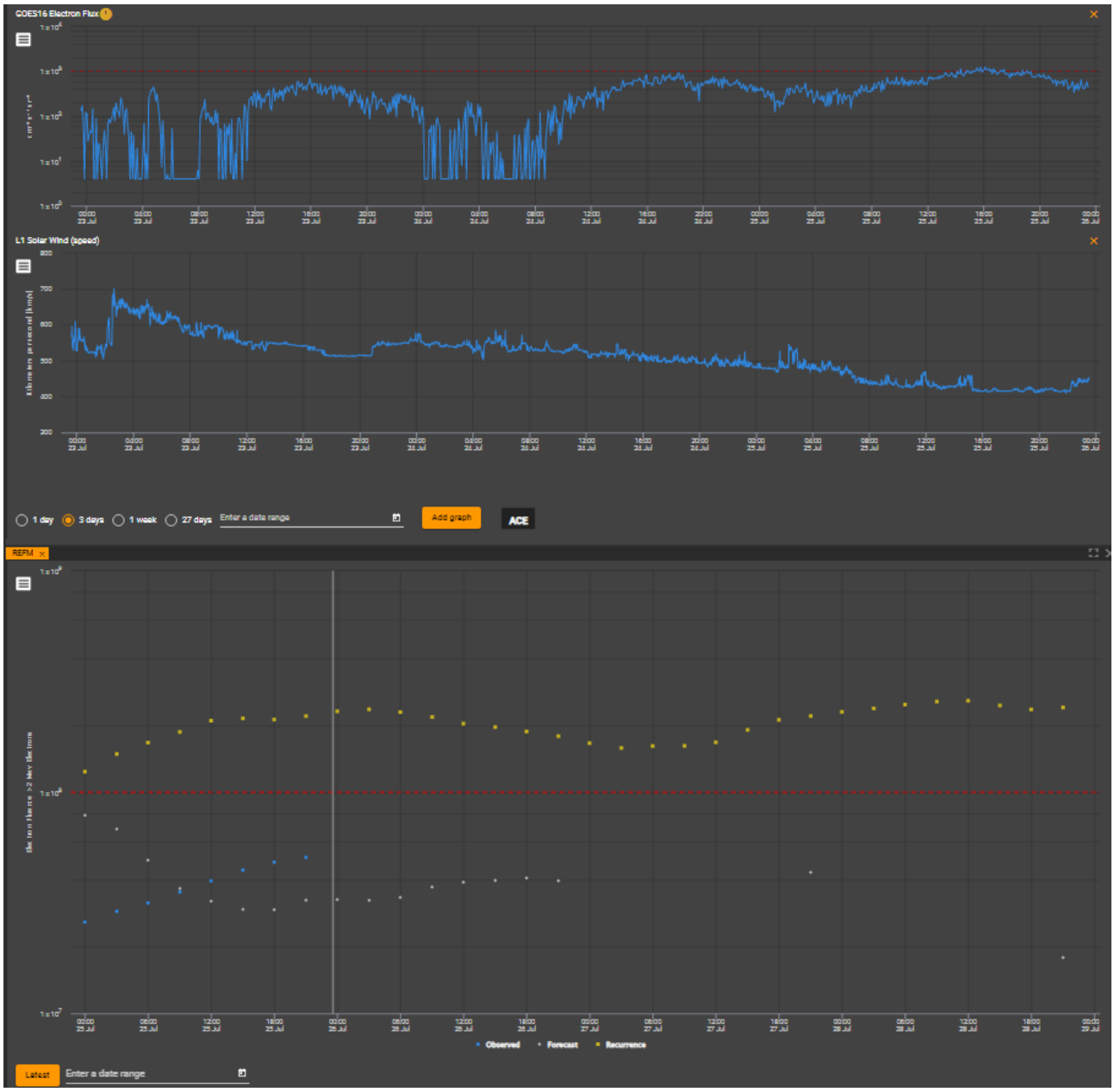
Figure 4: Past three days in high energy electron flux at GOES16 (top), showing increasing day-on-day amplitude in response to L1 solar wind speed (DSCOVR, centre). Also shown is the rising trend in observed 24-hour fluence (bottom graph, blue dots), persistence (yellow dots) and REFM forecast (white dots). REFM has greatly mollified its forecast given the CME over the UTC weekend, probably to too great an extent given the high speed stream from CH01/02 resumed as it waned. A forecast between the two (yellow and white trends) is considered the most likely scenario.



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